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Los Angeles County Flood Control District

J. W. Reagan

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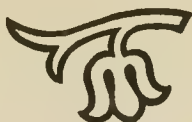
Los Angeles County Flood Control District

Report of J. W. Reagan

Engineer Los Angeles County
Flood Control District

Upon

The control of flood waters in
this District by correction of riv-
ers, diversion and care of washes,
building of dikes and dams, pro-
tecting public highways, private
property and Los Angeles and
Long Beach harbors.



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Filed with the Board of Supervisors of the
Los Angeles County Flood Control District
and Adopted January 2, 1917

In Accordance with Section 4
Of Los Angeles County Flood Control Act

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Los Angeles County Flood Control District

REPORT OF ENGINEER, J. W. REAGAN

Office of the Engineer of the Los Angeles
County Flood Control District,
Room 348 Court House
Los Angeles, California.

January 2, 1917.

Hon. Board of Supervisors,
Los Angeles County Flood Control District,
Los Angeles, California.

Gentlemen:

Pursuant to Section 4 of the Act of the Legislature of the State of California, known as the Los Angeles County Flood Control Act, by Resolution of your Honorable Body adopted on the 30th day of August, 1915, and amended on the 20th day of September, 1915, I was employed as Engineer to investigate carefully the best plan to control the flood and storm waters of the Los Angeles County Flood Control District and to conserve such waters for beneficial and useful purposes by spreading, storing, retaining or causing to percolate into the soil within said District, or to save or conserve in any manner, any or all of such waters, and to protect the harbors, waterways, public highways and property in said District from damage from such waters; and to obtain such other information in regard thereto as might be deemed necessary or useful for carrying out the purposes of said Los Angeles County Flood Control Act.

Said Resolution of your Honorable Body also directed me to make and file a Report with your Honorable Body, which should show:

1. A general description of the work to be done.
2. General plans, profiles, cross sections and general specifications of the work to be done.
3. A general description of the lands, rights-of-way, easements and property proposed to be taken, acquired or injured in carrying out said work.
4. A map which should show the location of the proposed work and improvements, and lands, rights-of-way, easements and property to be taken, acquired or injured in carrying out said work, and any other information in regard to the same that might be deemed necessary or useful.
5. An estimate of the cost of such work, including an estimate of the cost of the lands, rights-of-way, easements and property proposed to be taken, acquired or injured in carrying out said work and also of all incidental expenses likely to be incurred in connection therewith, including legal, clerical, engineering, superintendence, inspection, printing and advertising, and stating the total amount of bonds necessary to be issued to pay for the same.

Pursuant to said resolution of employment, investigations have been continuously carried on by me and my force of assistants ever since the same was adopted. In response to a special request made by your Honorable Body on the 26th day of September, 1916, I filed on the 2nd day of October, 1916, a report covering a plan for protecting the Los Angeles and Long Beach Harbors in said district, and the waterways, public highways and property in said district lying adjacent to the said harbors, from damage from the flood and storm waters of said district drained through the Los Angeles and San Gabriel Rivers and the Rio Hondo, which said report showed with respect to said particular matter all of the things required by the statute and your resolution of employment to be shown. Upon consideration of such report your Honorable Body did, however, on the 2nd day of October, 1916, order the same referred back to me to be modified so as to present a comprehensive plan for flood control work for the district.

In response to said request I modified and changed said report in the particulars requested, and filed the same as so modified and changed on the 20th day of December, 1916. Upon consideration of said Report so filed your Honorable Body did, however, again refer it back to me for further change and modification, requesting that work be provided for therein for the control of the storm waters of the Tujungas, the Los Angeles River above its junction with the Arroyo Seco, the Santa Clara River, and the Big Rock Creek and Little Rock Creek, and authorizing me to make such other changes as I might deem advisable.

By further order made by your Honorable Body on the 27th day of December, 1916, you requested me to make a further change and modification of said report with regard to the provision for the protection of Los Angeles and Long Beach Harbors so as to substitute for the plan presented in said report the plan indicated in my supplemental communication of Dec. 20, 1916.

In accordance with said last order of reference and said order of December 27th, 1916, I further modified and changed the report, and on December 29th, 1916, again filed it as so modified and changed. Upon consideration of said report as so filed however, your Honorable Body, on December 30th, 1916, did again refer it back to me for further change and modification, requesting that additional protection work be provided in the report for the control of the storm waters of the Tujungas, and authorizing me to make such other changes as I might deem advisable.

In accordance with said last order of reference I have further modified and changed the report, and do again herewith submit it for your consideration as a comprehensive plan for flood control work for the district. The report has been prepared and is filed pursuant to the provisions of Sections 4 and 5 of the Los Angeles County Flood Control Act, the resolution under which I was employed, and the several orders made by your Honorable Body hereinabove referred to.

While the report covers all of the points required by Section 4 of the Los Angeles County Flood Control Act to be shown therein, it has not seemed advisable, nor been convenient to follow the order in which said points appear in the statute. My plan has been to present, first, a general description of the work to be done, accompanied by a general map showing the location of the proposed work and improvements, and lands, rights-of-way, easements and property to be taken, acquired or injured in carrying out the work, with other information deemed useful, and to follow that with a particular treatment of the several parts of the work, presenting as to each, general plans, profiles, cross-sections and general specifications of the work to be done, a general description of the lands, rights-of-way, easements and property proposed to be taken, acquired, or injured in carrying out the work; and an estimate of the cost of the work and of the necessary rights-of-way, easements and property proposed to be taken, acquired or injured. In conclusion, I have summarized the estimates of costs for the various parts of the work and have added thereto estimates of incidental expenses likely to be incurred in connection therewith, and have given a statement of the total amount of bonds necessary to be issued to pay for all the work and expenses.

GENERAL DESCRIPTION OF WORK TO BE DONE

I may say at the outset that it has seemed advisable to follow in a general way the plans for flood control which were outlined by the Board of Engineers of Flood Control, in their report presented to the Board of Supervisors of Los Angeles County on July 27, 1915, and now on file in the office of said Board.

The work to be done resolves itself into four parts: First, the construction of both large and small dams in the mountainous areas; second, the protection of the banks of the smaller streams together with spreading and storing of waters of these streams for beneficial use; third, the straightening and rectification through river training and bank protection of the major streams; and fourth, protection to the harbors and shipping interests.

On the Pacoima Wash, about four miles above the mouth of the canyon, there will be built a concrete masonry dam 145 feet high. It will impound 3200 acre feet of water.

At a point where La Canada-Verdugo Road crosses the Arroyo Seco, locally known as

"Devil's Gate," there is to be constructed a concrete masonry dam 130 feet high, which will impound 6600 acre feet of water.

Two miles above the mouth of San Dimas Canyon the San Dimas Dam, a structure 145 feet above bed rock is to be built which will impound and conserve for beneficial use 2500 acre feet of water.

On the headwaters of the San Jose Creek in the old cienega just south of Lordsburg, the Pomona Dams and Reservoir will be located. The impounding dams will be of earth, with a maximum height of 40 feet, a top width of 16 feet, and a maximum bottom width of 221 feet. These two dams will provide a storage capacity of 2250 acre feet.

Cheek dams will be built in the small canyons at the headwaters of nearly all the creeks from which flood waters now empty onto the citrus belt between the East County line and the mouth of the San Gabriel River above Azusa.

Cheek dams will also be placed in the headwaters of the small canyons which devastate the foothill country between the mouth of the San Gabriel Canyon and north of Pasadena. The headwaters of Wilson Creek, Newhall Creek and Big and Little Rock Creeks will also have their flood waters controlled by the plentiful and judicious use of cheek dams.

The small canyons above Hollywood will have their menacing floods also controlled by small and numerous cheek dams.

Work is also to be done on the Sycamore Canyon Wash between the Verdugo Wash through Glendale and Tropic.

Spreading grounds will be provided at the mouth of Haines Canyon to take care of the runoff from this area.

The channel of the Ballona Creek will be enlarged, straightened and diked to care for the runoff coming into it.

In the Gardena Valley provision has been made to care for the increasing volume of flood waters originating southerly of Inglewood and north of Watson's Crossing.

Compton Creek will be widened, deepened and straightened from Vermont Avenue southerly.

The type of bank protection in general will consist of either a boulder levee thrown up by steam shovel, or a single row of fencing or double row of fencing filled in between, with orchard cuttings or brush and weighted down with rock.

In handling the Los Angeles River, the Rio Hondo and the San Gabriel River, it is realized that the water has a combined power for good or evil. We shall build training works so that this power of the river, for good, may be utilized in governing and straightening the present tortuous channel. These training works will consist of a double row of piling about five feet apart, on the stream face of which will be placed wire fencing, and the space between the piling filled with brush and rocks. At the especially dangerous points up and down the streams, bank protection will be used in order to confine these waters within the single channel, and to prevent the disastrous wanderings of these streams across the fertile valleys between the mountains and the sea. In general, this bank protection will consist of a double row of piling, or possibly a single row of piling, faced with barbed-wire or hog wire, and the space between the two rows of piling, or where the bank is steep, between the single row of piling and the cut bank, filled with brush and weighted down with stones. In all instances the growth of willows and all trees with a good, deep, firm root system will be encouraged along the banks and behind and in and among this bank protection. On the detritus cone of the San Gabriel River above El Monte there will be excavated a channel 300 or 400 feet wide and about four feet deep. The material from this excavation will be placed in levees on either side of the stream at distances varying from 600 feet to a quarter of a mile, the area between the minor channel and the levees to act as a spreading ground for the waters, that they may be absorbed into underground storage for beneficial use.

For the protection of the Los Angeles and Long Beach Harbors, a dike will be built from

the highlands at Dominguez Hill parallel to and northerly of the Pacific Electric Railway tracks, effectively causing all waters of the Los Angeles and San Gabriel Rivers and the Rio Hondo to flow to the location of the present bridge of the Pacific Electric Railway Tracks over the Los Angeles River, and known locally as the Cerritos Trestle, and thence almost due south through the low ground lying to the east of Long Beach Harbor to the Pacific Ocean at a point between Parker Avenue and Wabash Avenue, in the City of Long Beach or, generally speaking, between the Long Beach Harbor and the residential portion of the City of Long Beach. The waters in their course southward from Cerritos Trestle will be confined between levees, and sufficient highway bridges will be provided across the channel.

Before proposing protective works of any kind upon any stream course, it seemed advisable that the first step was to secure rights-of-way for official channels. I have not only been securing this right-of-way for you, but have secured it without a cent of cost to the Los Angeles County Flood Control District.

At a meeting held by the Flood Control Association in the Hall of Technology on January 15, 1916, it was tentatively agreed that data and an estimate for protective improvements to the amount of \$3,600,000 should be prepared for submission to the voters of the District for a bond issue. However, within the past few months many land owners, bankers, civic and commercial organizations have represented that realty values and securities have been so depreciated on account of damage by flood waters, that necessary steps should be taken to correct the same even though it takes a larger amount.

With the text of this report I submit a complete set of maps, general plans, profiles and cross sections, all of which are contained in the plate book filed with and made a part of this report.

The accompanying map (Plate I) shows the location of all of the work and improvements proposed in this report, and lands, rights-of-way, easements and property to be taken, acquired or injured in carrying out said work, and other information deemed useful in regard thereto. The general location of the channels and the work to be done is shown in red. The areas shaded green along the various channels represent the free rights-of-way for official channels now secured for you, and areas shaded brown along these streams show where we have determined upon official channels, but where free easements have not yet been secured. I would state parenthetically that this omission is only because of lack of time. The land owners have been very fair and generous with us in the granting of easements.

GENERAL SPECIFICATIONS OF WORK TO BE DONE, WITH GENERAL DESCRIPTION OF LANDS, RIGHTS-OF-WAY, EASEMENTS AND PROPERTY PROPOSED TO BE TAKEN, ACQUIRED OR INJURED IN CARRYING OUT THE WORK, AND ESTIMATES OF COST

The protective works which I shall recommend to you are proposed upon a base broad enough and in proper position, that they may either be the foundation for any further enlargement, or on the other hand, be complete within themselves as far as they go.

DEVIL'S GATE DAM AND RESERVOIR

The map of this reservoir is shown on Plate III. The profile, cross section and general outline of the dam are shown on Plate IV, and the emptying and filling curves shown on Plate V.

The dam will be made of plain concrete or Cyclopean masonry containing large stones. The top of the dam will be 130 feet above the solid bed rock. For stability the dam will depend entirely upon the force of gravity; however, for added strength it will be arched upstream in plan to a radius of 400 feet.

In addition to the duty of this structure as a dam it is so designed that it will carry over its top the La Canada-Verdugo Boulevard. The top of the dam is of sufficient width

to provide for a 20-foot roadway, with sidewalks on either side. This roadway is strong enough to carry a street railway should the necessity arise.

The storage capacity of the reservoir created by this structure will be about 6600 acre feet. The principle of the structure is for joint conservation and flood control. Its discharging apertures will be controlled by hydraulically operated gates which are large enough to release 7000 cubic feet of water per second. This volume is considered the maximum safe carrying capacity of the natural channel of the Arroyo Seco below the dam.

The surplus of any storm greater than 7000 second feet will be retained in the reservoir; the capacity of the reservoir, when worked upon this principle is large enough to reduce to 7000 second feet the flood of a storm 50% greater than the storm of February, 1914. The dam and reservoir not only give flood protection to the City of Los Angeles, and a material reduction to the flow of the Los Angeles River in flood times, but conserve the stored flood waters of the Arroyo Seco for the beneficial use of the City of Pasadena and other cities of the southeast.

The following is a general description of the land, rights-of-way, easements and property proposed to be taken, acquired or injured in the carrying out of this part of the work. A dam will be built across the Arroyo Seco approximately 200 feet below where the La Canada-Verdugo Road crosses the Arroyo Seco. The exact location of this structure cannot be determined until bed rock has been located by core drills. The top of the dam will be built to elevation 1069 feet above mean sea level, and the reservoir site will cover all that part of the Arroyo Seco Valley or Canyon, lying above the dam and within and below said 1069 foot contour, all as more particularly shown on Plate III.

The cost of these completed works is estimated at \$290,000. This amount is for construction purposes alone, as free easements of the entire reservoir site from both the City of Pasadena and other owners are already in your possession.

The Devil's Gate Dam and Reservoir have been approved as follows:

The general project and plan of the proposed dam at Devil's Gate were heartily endorsed November 29, 1916, by the Pasadena City Commission of the City of Pasadena.

Per A. L. HAMILTON, Chairman.

The Board of Directors of the Pasadena Board of Trade on November 4, 1916, approved the plan of the proposed Devil's Gate Dam and offer their hearty co-operation in the work.

J. H. PEARMAN, Secretary.

HUTCHIN'S DAM IN PACOIMA CANYON

This dam will be built at a point about four miles above the mouth of the Pacoima Canyon, for both flood control and conservation, but primarily for the protection of that part of the San Fernando Valley and the City of Los Angeles about the Town of Van Nuys.

Its height will be 145 feet and it will be 478 feet long on top. The dam will be made of plain concrete or of Cyclopean Masonry containing large stones. In type it will be of gravity section arched up-stream to a radius of 400 feet.

The map, profile and cross section are shown on Plate VI and the filling and discharging curves on Plate VII. The storage capacity of the reservoir is 3200 acre feet, which should reduce a flood as great as that of 1914, when the peak was estimated at 5400 second feet, to a flow of 2600 second feet, or a reduction of 52%. This will very materially lessen the menace and injury to property in the vicinity of Van Nuys.

The following is a general description of the land, rights-of-way, easements and property proposed to be taken, acquired or injured in carrying out this part of the work.

This dam will be built as above stated. The top of the dam will be at an elevation of 2265 feet above mean sea level. The reservoir site will include all that part of the Pacoima Canyon, lying above the dam and below the 2265-foot contour, all as more particularly shown upon Plate VI.

The cost of the works complete is \$359,460

The Hutchin's Dam and Reservoir project have been approved by the following city organizations of the San Fernando Valley and the City of Los Angeles:

"The San Fernando Chamber of Commerce, on December 7, 1916, passed a unanimous resolution endorsing and heartily approving the plan of the proposed Hutchin's Dam in Pacoima Canyon, and the general plan for flood control purposes in Los Angeles County."

FRED W. PRINCE, President.

H. C. CALDWELL, Secretary.

Plans for the Hutchin's Dam in Pacoima Canyon were endorsed by Resolution by the Van Nuys Chamber of Commerce, Van Nuys, California, November 16, 1916.

FRANK M. KEEFER, Secretary.

The San Fernando Board of Trade by Resolution on December 6, 1916, did heartily endorse and approve the general plan of the proposed Hutchin's Dam at Pacoima Canyon.

JOHN T. WILSON, President.

H. C. HUBBARD, Secretary.

The Board of Directors of the San Fernando Fruit Growers' Association on November 28, 1916, passed a Resolution unanimously endorsing the plan of a properly constructed concrete dam in Pacoima Canyon for the purpose of impounding and storing storm waters.

VOLNEY H. CRAIG, Secretary.

SAN DIMAS CANYON DAM AND RESERVOIR

This structure is located in the San Dimas Canyon about two miles above its mouth, in Angeles National Forest, upon the East $\frac{1}{2}$ of Sec. 24, T. 1 N., R. 9 W., S. B. B. & M., and upon land owned by the San Dimas Water Company, from which Company you have now a free easement, for construction of a dam and reservoir. The object to be accomplished by this structure will be flood protection for the intensely cultivated stretch of the San Dimas Wash above the City of Covina and the conservation and underground storage of flood waters.

Plate VIII shows the cross section and profile of the dam, and map of the reservoir site. Plate IX shows emptying and filling curves. The dam is to be constructed of plain concrete or Cyclopean masonry containing large stones up to $1\frac{1}{2}$ cubic yards. The dam will be 145 feet in height above bed rock and will have a crest length of 265 feet. In section, the dam will be of gravity type arched up-stream to a radius of 400 feet.

The impounding capacity is shown upon Plate IX, and is 2500 acre feet. This reservoir, like the Devil's Gate Reservoir, is intended as a retention reservoir, i. e., for both flood control and conservation. It will reduce a flood of 2800 second feet such as occurred in 1914 down to 1500 second feet, and these works like those of Devil's Gate will be supplied with discharging appliances large enough, that should the reservoir be full, or nearly so, when an on-coming storm is apparent, its contents may be released before the new storm reaches the dam. Like Devil's Gate, it is also provided with ample spill-way gates. The cost of this structure complete, including discharge pipes and cushion dams, will be \$278,000.

Lands, easements and rights-of-way necessary to be taken or acquired for these works may be generally described as follows:

The land necessary for the dam as located above, together with the area of the San Dimas Canyon above the dam, lying within and below the 1470-foot contour, mean sea level datum; all as shown on Plate VIII.

The San Dimas Dam and Reservoir project have been approved by the following Civic Organizations of the San Gabriel Valley:

Plans of San Dimas Canyon Dam unanimously approved by the Covina Chamber of Commerce, Covina, California, November 17, 1916.

H. A. MILLER, President.

JEROME REYNOLDS, Secretary.

Maps and plans for the control of the storm waters of the San Dimas Canyon have been endorsed at a special called meeting by the San Dimas Commercial Club of San Dimas, November 24, 1916 .

O. W. HIOKE, President.

C. C. CORWIN, Secretary.

By Resolution at a regular meeting, November 21, 1916, the Board of Trustees of the City of Covina, do resolve as follows:

That we hereby heartily endorse and recommend the flood control plans for Walnut Wash and for San Dimas Dam.

J. N. WILSON,

President of the Board of Trustees of the
City of Covina.

POMONA DAM AND RESERVOIR

Live Oak, Thompson, Williams and San Antonio Creeks

The flood waters of Williams Creek which are from a mountainous drainage of less than 400 acres, are a source of great danger and injury and are now flooding the new orchards on the San Antonio cone, thence passing down into the City of Claremont, either directly through the City of Claremont, or westward by the Foothill Boulevard to San Antonio Street and thence down San Antonio Street to the heart of the City of Pomona.

It has been desired by the property owners who are subject to this menace and injury that the storm waters of Williams Creek might be diverted either eastward to San Antonio Wash or westward to Thompson Creek.

As the San Antonio Wash is not within this district it would be unwise to attempt the diversion of Williams Creek into it. Its diversion westward into Thompson Creek may be safely undertaken, provided a final disposition of the water is provided for.

The flood waters from Thompson Creek are the result of a watershed of nearly 3000 acres, and furnish a flood peak of considerable volume, which now passes down across the Foothill Boulevard near its intersection with Williams Avenue on to the south, to and across the Kuns Tract, thence down Fulton Street where it divides part of it going southwesterly to the headwaters of San Jose Creek, and part down the County Boulevard to Garey Avenue, thence southerly to the heart of Pomona like the flood-waters of Williams Creek coming down San Antonio Avenue.

Live Oak Creek with a mountainous drainage area of approximately 1600 acres has a flood peak when its waters reach the Foothill Boulevard of about 700 cubic feet per second. From this point it begins to drop its detritus upon the orchard lands of the Evergreen Ranch and Tract No. 380.

Plate X shows the map, cross section and profiles of the Pomona Dam and Reservoir, located upon the old cienega partially within the city limits of Pomona on the headwaters of San Jose Creek south of Lordsburg. By the construction of this reservoir a place is provided for the final disposition of the waters of these three creeks.

Williams Creek will be diverted into Thompson Creek near where they both emerge from the mountains as shown on Plate XI and their combined waters carried down Thompson Creek channel to the Foothill Boulevard where these combined waters will be joined with the waters from Live Oak Creek, which are to be diverted down that portion of Williams Street which is north of the Foothill Boulevard. From the Foothill Boulevard southward the combined flood waters of the three streams, Williams Creek, Thompson Creek and Live Oak Creek will be conveyed down in a cement conduit or roadway to the Pomona reservoir, all as shown on Plate XI and XII.

Where Williams Creek crosses the center line of Section 27, Township 1, North, Range 8 West, there will be constructed a low earth dam for diverting the waters of Williams Creek to the Southwest, through a channel which is to be dug. This channel will be approximately twenty feet wide and two feet deep.

The material excavated from this channel will be thrown up on the lower side, forming a small levee.

The profile and cross section of Williams Creek will be found on Plate XII. The combined waters of Thompson and Williams Creeks will flow in the present natural channel of Thompson Creek as far south as Base Line Way, no work being done on the channel from Base Line Way to the Foothill Boulevard. The waters will continue to flow in the natural channel. The bank of the stream will be protected by a double row of wire fencing filled with brush. The plan of this creek is shown on Plate No. XI, the profile and cross section on Plate No. XII.

The diversion of Live Oak Wash southerly along Williams Avenue will be accomplished by placing a dike across the present Live Oak Wash, near the intersection of Williams Avenue and Bowdoin Street the waters from this diversion being carried southerly along Williams Avenue in a concrete channel. The profile and cross section of this diversion is shown upon Plate XII, the location is shown upon Plate XI. The profile and cross section of the conduit which is to convey the combined waters of the three streams, Williams, Thompson and Live Oak Creeks, from the Foothill Boulevard to the Pomona Reservoir is shown on Plate XII. The rights of way necessary for all of this work are shown between the red lines on Plate XI.

The Pomona reservoir will provide storage for 2320 acre feet of water when the water surface is at the 1000 foot contour. The area of the watershed of the three streams draining into this reservoir is approximately 4800 acres and inasmuch as it has a fairly good brush cover, it is estimated that the maximum flood peak from this territory will not exceed 1500 second feet. It is also estimated that the amount of water that would be delivered to the reservoir during a storm similar to that of 1914 or 1916, would not exceed 1500 acre feet, which is 75% of the storage capacity up to the 1000 foot contour.

This still permits of 6 feet free board. In case of an emergency the reservoir may be safely filled three feet more, allowing storage of nearly 3000 acre feet, or furnishing provision for flood waters of a storm twice as great as that of 1916. Filling to this height may be allowed only at will as the discharge valves provide for 500 cubic feet per second to San Jose Creek, and 500 cubic feet per second to Walnut Creek.

This reservoir plan will not only entirely eliminate the baneful effect of the flood waters from the canyons as discussed by the Citizens' Committee of Pomona in their report of May 15, 1916, but also save them the necessity of a large part of the cost of the street paving and high curbing which they advised in this report, but it should be plain from the contour map that not only will it remove the menace of the Williams and Thompson Creek flood waters from these cities, but that the flood waters of all the territory between the Base Line Road and Cucamonga Street in Pomona and Claremont may be carried by those locally interested, directly westward and delivered into this reservoir, instead of going southward through the city of Claremont. This possibility of the proposed plan is one of almost inestimable value to these two cities. Again, it is also of very great value to the city of Lordsburg to have the flood waters of Live Oak Creek entirely removed from their city to the reservoir.

The above outlined benefits arising from this plan of flood control are undoubtedly enough, but the selection of such a reservoir site in this locality has some other peculiarly valuable characteristics. The contour map shows that it would be possible to divert a portion of the San Antonio Canyon flood waters to it and these waters might again be passed from the Pomona reservoir through the divide upon the west with a very slight cutting into the Pudding Stone or Mount reservoir site, located by the Board of Engineers Flood Control, at the head waters of Walnut Creek Wash, in their report to the Board of Supervisors of Los Angeles County, filed July 27th, 1915. Another possibility of this reservoir is that any surplus waters of San Dimas Canyon which can be conveyed to the Pudding Stone reservoir can also be conveyed to this reservoir. The aggregate assessed values of the cities of Pomona, Claremont and Lordsburg is approximately \$9,000,000, showing a combined property value of nearly \$30,000,000, and I have no hesitancy in saying that this reservoir, if built and

properly controlled will remove the menace of the mountain flood waters from all of this property.

The dam is shown upon Plate X. It is a massive earth dam 3300 feet long with a maximum height of but 41 feet, 16 feet wide on top and 46 feet wide at the surface when the reservoir is full to the 1000 foot contour, and a maximum base width of 221 feet. When full it represents a surface area of 210 acres.

It is intended to construct a sunken concrete roadway from the Foothill Boulevard to the North City limits of Pomona to carry the combined flood waters of Thompson's, Williams' and Live Oak Creeks. At the North City limits of Pomona these flood waters will be received by a concrete conduit and conducted to the Pomona reservoir. Both the roadway and conduit are designed to carry from 2500 second feet to 2700 second feet, or double the volume of the 1916 flood.

Profile and cross section of protection dikes or walls to be built upon the west side of San Antonio Wash are shown on Plate XXII. The location of these dikes are shown on Plate XI. These dikes will be made of large boulders cemented together and enclosed in fence wire.

On the 350 acres at the head-waters of Williams Creek, it is intended to spend \$1100 in the construction of about 35 check dams. On the 2880 acres, at the head-waters of Thompson's Creek \$8900 is to be spent in constructing about 270 check dams. On the head-waters of Live Oak Creek, consisting of 1650 acres, \$5000 will be required to construct about 160 check dams.

The following is a general description of the land, rights of way, easements and property necessary to be taken, acquired or injured in carrying out the work on these four creeks, or washes, and the proposed Pomona Dam:

Williams Creek: A 50-foot strip of land extending from the intersection of Williams Creek, with the southerly boundary of the northeast $\frac{1}{4}$ of Section 27, Township 1 North, Range 8 West, thence southwesterly to a point in Thompson Creek about 700 feet north of the south line of said Section 27, as particularly shown on Plate XI.

Thompson Creek: The present wash channel of Thompson Creek from its beginning down to Base Line Road.

A strip of land extending from the intersection of the present wash channel with Base Line Road, southwesterly following the present course of the westerly part of Thompson Creek to the intersection of Foothill Boulevard and Williams Avenue. Said strip of land varying from 100 feet to 200 feet in width.

A strip of land extending from the intersection of Foothill Boulevard and Williams Street, southwesterly to a point in the northerly boundary of the City of Pomona about 400 feet east of the easterly line of the City of Lordsburg. Said strip being 60 feet wide and being occupied by a highway known as Williams Avenue from Foothill Boulevard to Grove Street, and below Grove Street partly by a narrow channel with low cement walls.

A strip of land about 50 feet in width extending from the intersection of Williams Avenue with the northerly boundary line of the City of Pomona, southwesterly, to the intersection of the westerly boundary line of the City of Pomona with the Santa Fe Railroad, thence on a curve to the right, with a radius of 2084 feet, from the Pacific Electric Railway to the Southern Pacific Railroad track near the 1005 foot contour, all as shown on Plate XI.

Live Oak Creek: A strip of land extending from the intersection of Bowdoin Street and Williams Avenue due south to Foothill Boulevard, 60 feet wide now occupied by the public highway known as Williams Avenue, as particularly shown on Plate XI.

Pomona Dam and Reservoir: A parcel of land bounded as follows:

Beginning at a point where the 1005-foot contour intersects the westerly boundary line of the City of Pomona near the Southern Pacific Railroad track; thence in a general westerly direction following said contour to a point 300 feet southerly of the southerly corner of the

lands common to Edwin T. Keiser and John S. Long; thence in a general southwesterly direction across the valley to the 1005-foot contour, being about 600 feet southeasterly from the northeast corner of the land of John T. Lawrence, thence in a general easterly direction to a point 400 feet easterly of the west boundary line of the City of Pomona; thence in a general northeasterly direction a distance of about 600 feet to an isolated hill in the lands of Theresa P. de Vejar; thence in a general northeasterly direction to the right of way of the Southern Pacific Railroad; thence along the right of way of said railroad, a distance of approximately 700 feet to the 1005-foot contour; thence in a general westerly direction along said 1005-foot contour to the place of beginning; all as shown on Plates X and XI.

San Antonio Creek: A strip of land as shown on Plate XI, sufficient in width for a location for the protective dikes above referred to.

Said strip being all located upon, or near to the present westerly boundary of the San Antonio Creek channel, and near the boundary line between Los Angeles and San Bernardino Counties.

The total amount necessary for all the foregoing works in the Pomona Reservoir, Williams Creek, Thompson Creek, Live Oak Creek and the San Antonio Creek is \$272,400.00, of which amount \$69,455 is for right of way.

The Pomona Reservoir project has been approved as follows:

Maps and plans show they were approved by resolution by the City Council of Pomona, December 12, 1916.

T. R. TROTTER, City Clerk.

Map and plans were approved by the Chamber of Commerce of the City of Pomona, December 11, 1916.

W. H. SCHUREMAN, Secretary.

Maps and plans were approved by the City Council of Claremont, December 13, 1916.

FRED A. BACON,
FOREST WENECKE,
EDWIN F. GOFF,
JAMES ROBINSON,
T. A. HICKCOX.

Maps and plans were approved by the City Council of Lordsburg on December 12, 1916.

C. C. HUFF, President,
T. J. STEVES, Clerk pro tem.

CHECK DAMS AND IMPOUNDING RESERVOIRS

The term "Check Dams" has been applied to any artificial obstruction of stone or logs, or any combination of stone, logs and brush which obstructs a stream bed completely from one side to the other. In this way the plane of the water is made to rise 6 feet to 8 feet above the stream bed at the dam.

The basic idea of the check dam is the flattening at will of the grade of a channel which in its natural state is so steep as to cause a rapid and destructive storm runoff.

Inasmuch as large numbers of check dams are needed per channel they must be constructed in such a manner and of such material as will reduce their unit cost to a minimum. For this reason they are usually made of boulders and loose rock found within a short radius of the dam.

The heights of check dams vary from 4 feet to 8 feet, depending upon the conditions of side rock and bed rock, and upon the grade of the canyon.

There is no cement used in the construction, but the boulders and flat stones are roughly fitted and "shingled" one on top of another. The courses are pitched backward and downward and being somewhat locked together, the whole forming a stable dam. At its base the dam is approximately as thick as it is high. The sides of the dam should be built some-

what higher than the central part, so as to direct the overfall away from the sides or banks.

The channels where they can be used to the best advantage are those which have a more or less V shaped section or a bottom width of not more than 15 feet with side slopes of 1:1.

This will locate them in a zone constituting approximately the upper 2/3 of a watershed. This is also where the grades are steepest and the precipitation is the heaviest.

These check dams can best be located as they are being built, for the location depends largely upon the availability of material, and in estimating with the eye the amount of material in a stretch of 300 feet or 400 feet of channel, it is impossible to say whether it would be sufficient for 4 or 5 or 6 check dams. Generally speaking the dams will be located at narrow places where there is something of a basin above them, and at fairly uniform distances apart.

Check dams similar to those recommended by the majority report of the Board of Engineers Flood Control, and as hereinabove described will be built in the mountainous areas of the district. The location of the canyons in the following list will be found upon Plate I. The list below shows the names of the canyons in which work is to be done, the acreage in the mountainous watershed and the amount of money to be spent in each canyon.

Name of Canyon	Acreage	Cost
Laurel	1212	\$ 2,420
Nichols	619	1,857
Brush (Hollywood).....	712	1,425
(Small canyon west of Brush Canyon).....	420	840
Eaton	4260	8,500
Rubio	910	1,815
Los Flores	300	600
(Small canyon bet. Eaton and Rubio).....	314	628
Sawpit	4160	21,300
Hook	433	866
Small canyon east of Hook Canyon.....	137	290
San Dimas	1600	3,200
Little Dalton	2164	4,325
Small canyon above Duarte	892	1,785
Bailey	392	784
Small canyons above Sierra Madre.....	1685	3,365
Wilson Creek	1150	6,000
		<hr/>
		\$60,000

In addition to the above amount of \$60,000 appearing under the item of checkdams, other items appear under various subheads, making a total to be expended in checkdam construction of \$103,000. Impounding reservoirs aggregating \$1,045,910, are provided for at Devil's Gate, Pacoima Canyon, San Dimas Canyon and Pomona, making a grand total of \$1,148,910 for the construction of checkdams and impounding reservoirs.

BALLONA CREEK

The plan for the flood waters of Ballona Creek is shown upon Plate XIII. The lands required for rights of way are bordered by red. That portion of which the County has already received free easements is shown between the dotted red lines, and the portion of which we have not received free easements is enclosed within the heavy red lines. But a very small area now remains over which we have not secured free easements, and this area is in localities where improvement to the stream is not altogether necessary.

Plate XIII also shows profile, cross section and carrying capacity of the channel. The work extends from the western limits of the City of Los Angeles to the Pacific Ocean, outside the tide gates of Playa del Rey, a distance of about eight miles.

The side levees are to be built of earth, and from the material excavated from the channel. The plan and estimate also includes the removal of the large stones lying in the ocean entrance near Playa Del Rey, connecting the lagoon with the ocean, and making the necessary adjustments with local property owners for changing the position and insuring the proper operation of the tide gates.

The land, rights of way and easements necessary to be taken or acquired for this work may be generally described as follows:

A strip of land 50 feet in width extending from a point on the right of way of the Pacific Electric Railway Venice short line division, about 250 feet east of the point of intersection of said railway right of way with the southwesterly boundary line of the lands of the heirs of Louis Sentous, Sr., thence southerly to a point in said last named line about 400 feet, thence southeasterly along said line to Washington Boulevard.

A strip of land about 50 feet in width extending from a point in the boundary line between the lands of the heirs of Louis Sentous, Sr., and the Southwestern Packing Company, about 400 feet northeast along said line from Washington Boulevard; thence southwesterly to the junction of Washington Boulevard and the strip above described.

A strip of land 100 feet in width extending southerly from the junction of the two strips last above described, crossing Washington Boulevard and following the general meandering of the channel to its junction with the main channel of Ballona Creek, a distance of about 900 feet.

A strip of land 100 feet wide commencing at a point in the present Ballona Creek Wash about 700 feet east of Moynier Lane and following the general meanderings of said channel to a point therein about 400 feet east of the public highway known as First Street, Palms, thence gradually increasing to a width of 200 feet at said street. A strip of land 200 feet in width extending from said First Street, Palms, following the general meanderings of said Ballona Creek channel to the boundary line between the lands of S. M. Bernard Company and William T. McLaughlin.

A strip of land 250 feet wide extending from the end of the last described strip in a general westerly direction to the concrete tide gate near the boundary line of the City of Venice, thence on a curve to the left, following the general line of the Lagoon at Playa del Rey, a distance of approximately 2000 feet to the Pacific Ocean. As more particularly shown upon Plate XIII.

The total cost for the correction of Ballona Creek is \$80,875.

The Ballona Creek project has been approved as follows:

The Board of Trustees of the City of Venice, assembled this 15th day of December, 1916, at 11 o'clock, A. M., do endorse the plan recommended by the County Engineer, J. W. Reagan, for the care of the flood waters, in Ballona Creek and Valley.

C. Y. BURNS, City Clerk,

E. A. GERETY, President of the Board of Trustees.

Resolved, that the general plan of the Los Angeles County Flood Control Board to take care of the flood water of Ballona Creek as presented to the Venice Chamber of Commerce, on December 9th, with a complete delivery of the flood water into the ocean provided for, is accepted and approved.

ALTA D. MARSHALL, Secretary.

Culver City, December 14, 1916.

Plans for control of the floods of the Ballona were approved by the Business Men's League of Culver City and the Culver Investment Company. HARRY H. CULVER.

GARDENA VALLEY AND NIGGER SLOUGH

The storm water problem of this Valley is becoming one of serious moment. During the past year three important County Boulevards were rendered impassable over periods varying from a few weeks to a few months—referring to Western Avenue, Wilmington-Redondo and Harbor Boulevards.

The troubles and problems of this valley resolve themselves into two sections; the upper

one containing in round numbers 36 square miles, or more than 20,000 acres, originally drained into a sink shown upon Plate XIV, locally known as Johnson's Lake. The present channel from Johnson's Lake is not adequate to permit the waters of the great storms to escape fast enough, consequently this lake is created and often reaches a surface area of nearly 1000 acres, and generally remains weeks before subsiding.

Plate XIV and Plate XV are maps of the channel, and Plate XVI shows the profile, cross section and carrying capacity of the channel at different points.

Free easements over six and one-half miles of the lower end of this channel have been secured, and I might add, actual construction work in harmony with the plans and specifications of this office are already under way by the Dominguez interests.

The estimated cost of this rectification work throughout its entire length of thirteen and one-half miles, from Pine Street in Inglewood to tide water near Watson Station, less any allowance for cost of right of way, is \$56,590.

The rectification and enlargement of this channel will have a beneficial effect over a territory of about seventy square miles in area, or more than 40,000 acres. This is now assessed at approximately \$13,000,000.

The lands, right of way and easements necessary for this work is generally described as follows:

A strip of land 50 feet in width extending from Pine Street, Tract No. 2464, about 100 feet east of Lock Haven Street, thence south to Garden Avenue in said tract; thence southeasterly to a point in Lincoln Avenue, in Tract No. 1631, about midway between Orange Avenue and Walnut Avenue.

A strip of land 100 feet in width extending from said point in Lincoln Avenue southeasterly in a straight line to a point in Arlington Street, about 600 feet north of Southern Avenue; thence south following the line of Arlington Street to Southern Avenue.

A strip of land 150 feet wide and about 1200 feet long extending northeasterly from the intersection of Arlington Street and Southern Avenue.

A strip of land 150 feet in width extending from the intersection of Arlington Street and Southern Avenue, southwesterly to a point in the south line of the northeast quarter of Section 22, about 550 feet east of the center of said Section 22.

A strip of land 125 feet in width extending from said south line of the northeast quarter of Section 22, following in general the meanderings of the creek, emptying into the headwaters of Nigger Slough and passing through Bridgedale, and southerly of the Town of Gardena, to the intersection of said channel with Victoria Street.

A strip of land extending from said last mentioned point in Victoria Street in a general southeasterly direction across Nigger Slough, to the intersection of Wilmington Avenue and Wilmington Street and varying in width from 100 feet at the point of commencement to 225 feet about 3000 feet northwesterly of the intersection of Wilmington Avenue and Wilmington Street. A strip of land 225 feet wide and extending from said last mentioned point in a general southeasterly and southerly direction to the right of way of the Pacific Electric Railway just northerly from the Long Beach and Redondo Road at Watson crossing.

All as more particularly shown on Plates XIV and XV.

The Gardena Valley Channel project has been approved by the following federated societies of the Gardena Valley:

"Location of channel and plans approved by the Federated Societies of the southwest of Gardena, August 10, 1916. C. L. TILLEY, Secretary."

"The Southwest Federation of Civic Associations of Los Angeles County at Lenox, August 21, 1916. H. J. ANDERSON, Secretary."

VERDUGO WASH

Plate XVII shows map, plan, profile and cross section of the improvement to be made on Verdugo Wash. This improvement consists of piling and wire enclosing a channel behind

which on either side of the channel, trees are to be planted for permanent bank protection. The right of way has already been secured by the City of Glendale from Ninth Street to above Verdugo Road. The easements and deeds for this right of way are now in the possession of the City of Glendale. Between Pacific Street and the Los Angeles River free easements have been secured, and are in the possession of this office. No easements have as yet been secured between Brand Boulevard and Pacific Street, but it is understood that these easements will be granted free.

The lands, rights of way and easements for this work consist of a strip of land 90 feet wide, extending from the northerly boundary line of the City of Glendale in a general southerly and southwesterly direction, following generally the meanderings of the present storm channel of the Verdugo Wash to its point of discharge into the Los Angeles River, all as more particularly shown on Plate XVII. The cost of this work is \$99,800. The Verdugo Wash project has been approved as follows:

“Maps and plans approved by the Board of Trustees of the City of Glendale, October 26, 1916.
T. W. WATSON, City Manager.”

SYCAMORE CANYON

Plate XVIII shows the work to be done for protection against the flood waters of Sycamore Canyon as it passes through the Cities of Glendale and Tropic. This plate shows map, profile and cross section.

In Tropic, only the cleaning out the brush and slight rectification of the channel as shown upon the plan, are to be done. The City of Glendale offers to provide the right of way between Verdugo Road and the City Limits of Tropic.

The following is a general description of the lands, easements and rights of way to be taken, acquired or injured in executing the work on the Sycamore Canyon Wash:

For the sand-trap the following bounded parcel of land; beginning at the intersection of Sycamore Canyon Road with the easterly line of the land owned by Dodge, Harwood and Sinclair Water & Development Company; thence southerly about 175 feet to a point in the fence line; thence southeasterly across the valley for a distance of about 120 feet to the 654 foot contour; thence in a general northeasterly direction along the 654 foot contour and around this contour on the other side of the Valley, going in a northwesterly direction to the northerly line of the present bank; thence in a northerly direction to the south line of the Sycamore Canyon Road, thence southwesterly along the Sycamore Canyon Road to the place of beginning. From the last above described point the channel will follow Sycamore Avenue southwesterly and southerly to a pump house on the property of the Tupper Robinson Company, Incorporated, near the southerly boundary of the City of Glendale; from this point a strip of land 40 feet wide will be required running southwesterly and southerly to a point about 100 feet easterly from the intersection of the southerly boundary of the City of Tropic with the Salt Lake Railroad.

Also a strip 40 feet wide commencing at a point about 200 feet northerly from the intersection of Treadwell Street with the San Fernando Road; thence southeasterly to the easterly side of the Salt Lake Railroad; thence following the Salt Lake Railroad to Marguerite Street; thence westerly to the west side of the Salt Lake Railway; thence southerly along said Railway to a point near the intersection of the San Fernando Road and Edward Avenue, all as more particularly shown on Plate XVIII.

The cost of making the rectification of Sycamore Wash, as shown on Plate XVIII is \$28,925. Of this amount \$5000 is for right of way for the construction of a sand-trap, Plate XVIII, 2. This sand-trap will protect the streets and property of Glendale and Tropic from being covered with large deposits of sand.

The Sycamore Canyon Wash project has been approved by the Board of Trustees of Tropic.

Maps and plans approved by the Board of Trustees of the City of Tropic, November 1, 1916.
FRANK E. PETERS, Chairman,
W. C. WATTLES, City Engineer.

SAN JOSE CREEK

Plate XIX shows map, profile and cross section for the care of flood waters in this creek. A free easement for an official channel 75 feet in width for the entire length and area shown upon this map has already been received from the owners.

The work necessary to be done upon San Jose Creek consists of cleaning and clearing the present channel and of cutting off sharp bends as shown upon the map. The amount of money required for the correction work is \$8000.

The land, easements, rights of ways necessary to be taken or acquired for these works may be generally described as follows:

A strip of land 75 feet wide commencing at the intersection of Pomona Boulevard and the westerly line of the property of Michael J. Seanlon; thence in an easterly direction, following approximately the line of the old channel to a point in a westerly line of Pomona City Park about 150 feet from the Pacific Electric Railway on Huntington Boulevard; all as more particularly shown on Plate XIX.

Approval of plans for the correction of this creek is evidenced by the complete co-operation of adjacent land owners in their donation of the rights of way.

PASADENA AND ALTADENA

Plate XX shows the map and profile and cross section of the work to be done in this vicinity. This work extends from a point just east of Fair Oaks Avenue to the Arroyo Seco. The right of way necessary for these works will be 50 feet wide. The channel will be lined with concrete where the velocities are great. Use has been made of existing canyon beds to a large extent, and it is thought that the beds of these canyons are so stable that no serious erosion will take place. This stream channel will act as an intercepting channel to take the flood waters which now flow southerly through Altadena and on to the north part of the City of Pasadena, and conduct them in a generally westerly direction harmlessly to the Arroyo Seco, where they may be spread on the gravel cone to percolate into the soil for beneficial use.

The lands, easements and rights of way necessary to be taken or acquired for these works may be generally described as follows:

A strip of land 150 feet wide described as follows:

Beginning at a point in Lot 1, Section 4, Township 1 North, Range 12 West, approximately 650 feet west of the east line of said Lot 1; thence in a general westerly direction a distance of approximately 1000 feet.

A strip of land 150 feet wide described as follows: Beginning at the end of the strip last described and extending in a general westerly direction to the northeast corner of Tract No. 348; thence west along the north line of said Tract No. 348, in a westerly and a general southwesterly direction to a point in Lincoln Avenue about 500 feet northerly of Piedmont Avenue.

A strip of land 75 feet wide extending from the last above mentioned point in a general westerly direction to the intersection of the right of way of the Salt Lake Railroad and the northerly line of the Rancho San Pasqual in the Arroyo Seco. All as shown upon Plate XX.

The estimated cost of this work is \$30,320.

The proposed Flood Control Channel for the District north of Altadena project has been approved as follows:

The West Altadena Improvement Association on December 5, 1916, passed a resolution endorsing the plan as proposed for their protection against storm and flood water.

C. H. WOODS, President.

A. H. PERKINS, Secretary.

HAINES CANYON

The work to be done in Haines Canyon Wash, which embraces the settlement of Littlelands, now renamed Tujunga, and Sunland, is shown on plan, map, profile and cross section, on Plate XXI.

This plate shows the plan of work for the control of storm waters from Haines Canyon which for the upper part of the valley, is a wide, spreading and absorption ground for dropping the load of detritus which yet comes in considerable volume from the canyon.

The principle adopted here, in these works of building a large enclosure for the spreading of water and dropping its detritus is very common in Europe, but is quite the opposite of the storm drain method tried in this section two years ago.

The levees in the detrital cone will be thrown up with a steam shovel, raising the levees to a height of eight feet, and enclosing an area of 35 acres of practically worthless land. This land should be donated to the district through easements, as it is of no value for residential or agricultural purposes, its position and character being shown in the picture (photograph) following Plate XXI.

The land, easements and rights of way necessary to be taken, and acquired for these works may be generally described as follows:

A strip of land varying in width from 100 feet to 800 feet, more or less, beginning at the mouth of Haines Canyon approximately 1100 feet north of Los Angeles Avenue and 200 feet east of the Kings Highway; thence in a general southwesterly direction crossing El Centro Avenue at a point approximately 500 feet west of Haines Canyon Road and continuing in a southwesterly direction to a point in Michigan Avenue approximately 1800 feet west of Marshall Street. A strip of land 75 feet wide extending from said last mentioned point in a general northwesterly direction following the present bed of the Haines Canyon Wash to its junction with the Tujunga Wash just northerly of North Street and westerly of First Street; all as more fully shown upon Plate XXI.

The cost of this construction work will be \$33,500, exclusive of right of way.

WALNUT CREEK

Plate XXIII is a map of the Walnut Creek from the Rio Hondo to just above Citrus Avenue. The right of way necessary for this project is shown between the red lines on this plate. The channel will follow the present stream to a point approximately 400 feet east of Puente Avenue. From there to Vineland Avenue the wash has cut a new channel deeper and wider than its old one, lying to the north of the old channel. This new channel will be used and the old one abandoned. From Vineland Avenue to Rio Hondo the present stream bed will be followed. The right of way has been largely secured over this entire wash, and it is anticipated that all of it will be secured for the district, free of charge. The work to be done above Sunset Avenue is comparatively slight, as the water flows in a deep, well-defined channel. At certain of the worst places where erosion is now taking place, or is threatened, a fence will be built along the bank and filled with brush and orchard cuttings to prevent any further damage.

It is anticipated that the work being done on Walnut Creek by the local ranchers this winter will result in lowering the stream bed just above Puente Avenue from 1 to 2 feet. This will have a beneficial effect upon the stream for a long distance above Puente Avenue. It will be necessary to deepen and widen this channel to 30 feet on the bottom, and to protect the banks from erosion by constructing a single row of fence, and filling between it and the bank with orchard cuttings. A profile of this wash is shown on Plate XXIV.

The land, easements and rights of way necessary to be taken and acquired for these works may be generally described as follows:

A strip of land 75 feet wide, beginning at a point in the present bed of the Walnut Creek approximately 1000 feet north of Service Avenue and 400 feet east of Citrus Avenue; thence in a general westerly direction following the meanderings of the Walnut Creek Wash

to a point approximately 300 feet west of Puente Avenue, and 900 feet northerly of Francisquito Avenue.

A strip of land not less than 100 feet wide and varying in width extending from last above mentioned point in a general westerly direction to the present crossing of Covina Boulevard over the Walnut Wash and in general following the course of the cut or wash made new in the storms of 1915-16; thence a strip of land of varying width extending in a general southerly and westerly direction to the East San Gabriel River; all as more fully shown on Plate XXIII.

The cost of this work will be \$29,920.

SAN DIMAS WASH

Plate XXV shows the plan of work to be done on San Dimas Wash. Plate XXVI shows profile and cross section of this wash. The right of way necessary for stream channel is shown between the red lines on Plate XXV. This wash will be carried in a channel as wide as it occupied in the storm of January, 1916, from the mountains to where the wash now crosses the center line of Section 11, Township 1 South, Range 10 West, just east of Azusa Avenue. From this point on, a channel will be opened westward along the center line of Sections 10 and 11 to the Big Dalton Wash.

The policy to be pursued upon the San Dimas Wash is to reduce as much as is consistent the velocity of the waters and to cause them to percolate into the soil for beneficial use. In general the present banks will be followed from the mountains to the center line of Section 11. From the center line of Section 11 to the Big Dalton Wash a new channel will be dug with a steam shovel and a very substantial levee will be placed on the south side of the channel. In addition the banks will be protected from erosion. This cut-off of the San Dimas will remove the threatened menace to that large body of land lying south and west of Covina. As it is necessary to construct and maintain a channel for the combined flow of the Big and Little Daltons, it is deemed to be for the best interests of the entire district to place the waters of the San Dimas Wash in this channel, thereby necessitating the maintenance of but one channel from the center line of Section 10 to Walnut Creek.

The type of construction to be used will vary. On the upper reaches of the San Dimas Wash a steam shovel will be used to throw up large boulder dikes; lower down where the boulders become too small for this use a double wire fence filled with brush will be built, and possibly below this a single wire fence with brush between the fence and the bank will be built where feasible.

The land, easements and rights of way necessary to be taken or acquired for these works may be generally described as follows:

A strip of land of variable width beginning at a point where the San Dimas Wash issues from the mouth of the canyon near the northeast corner of Section 36, Township 1 North, Range 9 West; thence following the general meanderings of the present bed of the San Dimas Wash in a general southwesterly direction crossing Gladstone Avenue near the intersection of Sunset Avenue and crossing Glendora Avenue about 500 feet north of Walnut Street, crossing Citrus Avenue approximately 1200 feet north of Covina Boulevard to the center line of Section 10, Township 1 South, Range 10 West; thence leaving the present bed of the San Dimas Wash and continuing westerly along the $\frac{1}{4}$ section line to the junction of the Big Dalton Wash, all as more particularly shown upon Plate XXV.

The estimated cost of the right of way is \$6320 and for construction work \$31,510, making a total for the San Dimas Wash \$37,830.

The scheme of putting the waters of the San Dimas Wash and the Big and Little Dalton Washes into one channel as outlined before was approved by the interested local parties.

“By the West Covina Improvement Association on June 12, 1916.

RALPH T. LANG, Secretary.”

“The Baldwin Park Flood Committee on June 29, 1916.

W. P. MOORE, Secretary.”

BIG DALTON WASH

The plan of the work to be done on the Big Dalton is shown on Plate XXVII, which work extends from the mountains to its confluence with the Walnut Wash. The profile is shown on Plate XXVIII. The work which was done during the last summer by the ranchers along this stream has practically determined the policy of control. Along the greater part of its length the Big Dalton has been confined within a narrow channel having well defined banks, with the result that the water will flow more freely and faster to its mouth. The type of construction to be used on this wash is the same as that recommended for the San Dimas, namely, on the upper reaches, by throwing up boulders with a steam shovel to form dikes on either side, and lower down constructing a double row of wire fence filled with brush, or where the banks will permit, of a single row of fencing with brush behind.

From the mountains to the north line of the property owned by Ella P. Hubbard near the center of Section 9, Township 1 North, Range 10 West, the wash will be confined to its present channel. Near this point the water of the wash now flows south on Vincent Avenue and west on Cypress Avenue to the junction with the Little Dalton Wash. This water is to be taken out of the public highway and carried along the center line of Section 9 to the junction of the Little Dalton, thence down the channel of the Little Dalton to Cypress Avenue, where at present the two streams come together. From the junction of the Big Dalton and Little Dalton it is proposed to carry the stream in its present channel to a point just above the Pacific Electric Railway, Covina Branch. From this point to Walnut Wash the Big Dalton is a comparatively narrow stream, through a flat, fertile country.

From a point above the Southern Pacific to Central Avenue below Baldwin Park it will be advantageous to straighten this channel as shown on Plate XXVII. From Central Avenue to Walnut Wash the Big Dalton follows a well-defined channel until just above Merced Avenue, where it begins to wander, and the channel finally ends by running down the highway.

From Central Avenue to Walnut Wash the stream channel in its upper end is approximately 450 feet from, and parallel to Vineland Avenue. As this line is the dividing line between the end of the properties it is thought this will be the best location for the stream channel. It is proposed to carry this straight down this line 450 feet back from Vineland Avenue to a junction with Walnut Wash.

The land, easements and rights of way necessary to be taken or acquired for these works may be generally described as follows:

A strip of land of varying width, beginning at a point about 500 feet from the center of Section 21, Township 1 North, Range 9 West, S. B. B. and M., where the Big Dalton emerges from the canyon, and extending thence in a general southwesterly direction to a point approximately 300 feet southerly from Sierra Madre Avenue; thence a strip of land 100 feet wide beginning at said last mentioned point, and following in a general direction the meanderings of the present Big Dalton Wash in a southerly direction to the southerly line of Alosta Avenue; said point being approximately 650 feet east of Loraine Avenue.

A strip of land of varying width extending from said last mentioned point in a southwesterly direction and in general following the present meanderings of the Big Dalton Wash to a line between lands owned by Orrin A. Elliott and Charles F. Koendorfer.

A strip of land 100 feet wide running in a southwesterly direction from said last mentioned point, and in general following the meanderings of the Big Dalton Wash to a point in Citrus Avenue approximately 1200 feet south of Gladstone Avenue.

A strip of land 80 feet wide extending from said last mentioned point in a general southwesterly and westerly direction to a point in Cerritos Avenue, approximately 600 feet north of Walnut Avenue.

A strip of land 60 feet wide beginning at said last mentioned point and extending in a general southwesterly direction following the general meanderings of the Big Dalton Wash to the southerly line of the land owned by the Iowa Land Investment Company.

A strip of land 100 feet wide extending from said last mentioned point in a general westerly direction to the present bed of the Little Dalton Wash; thence following the bed of the Little Dalton Wash in a southwesterly direction to its junction with the Big Dalton, at the corner of Azusa Canyon Road and Puente and Azusa Bridge Road; thence in a general southwesterly direction following in general the meanderings of the present bed of the Big Dalton Wash to a point in Merced Avenue, approximately 450 feet southeasterly of Vineland Avenue; thence in a direct line parallel to Vineland Avenue to the junction with Walnut Creek. All as more particularly shown upon Plate XXVII.

The cost of the work will be \$99,060.00.

LITTLE DALTON WASH

The work proposed to be done on the Little Dalton Wash is shown on Plate XXIX. The profile is shown on Plate XXX. It is proposed to carry this wash from the mountains largely within the confines of the present stream bed, except for some minor changes where the channel is very crooked and should be straightened.

The land, easements and rights of way necessary to be taken or acquired for these works may be generally described as follows:

A strip of land of varying width beginning at a point where the Little Dalton Wash emerges from its mountainous canyon in the southeast $\frac{1}{4}$ of Section 20, Township 1 North, Range 9 West, S. B. B. & M.; thence in a general southwesterly direction in general following the course of the present Little Dalton Wash to a point in Lorraine Avenue approximately 950 feet north of Sierra Madre Avenue.

A strip of land 75 feet wide beginning at said last mentioned point and in general following in a southwesterly direction the present course of the Little Dalton Wash to the intersection of Minnesota and Electric Streets in the City of Glendora.

A strip of land 50 feet wide beginning at said last mentioned point and extending in a general southwesterly direction, thence following the course of the present bed of the Little Dalton Wash to a point near the intersection of Grand Avenue and Foothill Boulevard.

A strip of land 75 feet wide beginning at said last mentioned point and extending in a general southwest direction along the present course of the Little Dalton Wash, passing near the intersection of First Street and Soldano Avenue; continuing thence in a general southwesterly direction and following the course of the present Little Dalton Wash to its junction with the Big Dalton Wash near the southerly line of the land owned by William H. Parks at Vincent Avenue; all as more fully shown upon Plate XXIX.

The cost of the work will be \$26,920.00.

SAW PIT WASH

Plate XXXI is a map of Sawpit Wash; Plate XXXII is a profile of Sawpit Wash. The waters of this wash are to be spread broadly over the wide gravelly bed above the Foothill Boulevard, and all the water possible allowed to percolate into the ground for beneficial use. Below Foothill Boulevard it is to be confine within a comparatively narrow channel as far as one now exists. With this wash treated in this way below the mouth of the canyon, coupled with the check dams which are to be built in the headwaters, it is expected that all of this water will percolate into the ground and none of it reach the Rio Hondo as a surface flow. The right of way necessary for this is shown in red on the accompanying map. The improved channel will occupy all of the present wash and side cutting will be prevented by the construction of a single or double row of fencing filled with brush and rock.

A general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured is as follows:

A strip of land of varying width described as follows: Beginning at the approximate mouth of the Sawpit Canyon where the present wash crosses the east boundary line of the City of Monrovia; thence in a general southerly direction following the present course of the

Sawpit Wash to the intersection of Mountain Avenue and Duarte Avenue, thence continuing in a general southerly direction along the present bed of Sawpit Wash as far as the stream now flows in a definite channel; all as more fully shown upon Plate XXXI.

The estimated cost of this work is \$4,835.

SANTA ANITA WASHES

The general plan of the Santa Anita Wash is shown upon Plate XXXIII. The profile and cross section are shown upon Plate XXXIV. The rights of way necessary for the carrying out of this plan are included within the red lines shown upon Plate XXXIII. The wash will be confined to its present channel all the way. It is proposed to protect the banks of this wash from erosion by brush and wire fences, either in single or double rows, as the necessity of the case may determine.

A general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured is as follows:

A strip of land 150 feet wide described as follows:

Beginning at a point where the little Santa Anita Wash crosses Live Oak Avenue; thence in a general southeasterly direction to the junction with the big Santa Anita Wash.

A strip of land 200 feet wide described as follows:

Beginning at a point on Live Oak Avenue approximately 1400 feet east of the intersection of Live Oak Avenue and Santa Anita Avenue; thence in a general southerly direction following the present course of the Big Santa Anita Wash to Foothill Boulevard.

A strip of land 300 feet wide described as follows:

Beginning at said last mentioned point and following the general course of the big Santa Anita Wash in a general southerly direction to a point on Valnett Avenue approximately 400 feet west of Tenth Avenue.

A strip of land 100 feet wide extending from said last mentioned point in a southerly direction following the general course of the present Big Santa Anita Wash to its junction with Lexington Wash; all as more fully shown upon Plate XXXIII.

The estimated cost of this work is \$27,350.

EATON WASH

The work to be done on Eaton Wash is shown on Plate XXXV.

The right of way necessary for the work is shown between the red lines on this plate. The profile and cross sections of the wash are shown on Plate XXXVI. On the upper reaches of the wash it is proposed to spread the waters entirely over the present stream bed, causing them to percolate as much as possible into the soil and to be conserved for the beneficial use of all those using underground water within this basin. On the lower end of Eaton Canyon Wash it will be necessary to contract the channel and cause scouring, and to this end the flow is to be confined if possible between earth dikes. The stream will follow the present channel.

A general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured is as follows:

A strip of land of varying width described as follows:

Beginning at a point in the present bed of the Eaton Wash approximately 3600 feet northerly of the east end of North Avenue; thence in a general southerly direction following the present course of the Eaton Wash crossing Broadway in the City of San Gabriel approximately 650 feet westerly of Rosemead Avenue and continuing thence in a general southeasterly direction following the meanderings of the present bed of the stream of the Eaton Wash to a point approximately 800 feet east of Ellis Lane and northerly of the Southern Pacific Railroad, then following the general meandering of Eaton Wash in a southerly direction to its present junction with Lexington Wash, all as more fully shown on Plate XXXV.

The estimated cost of this work is \$27,650.00.

RUBIO CANYON WASH

The work to be done on Rubio Canyon Wash is shown upon Plate XXXVII. The right of way necessary for this is shown in red on this plate. The brown lines show the right of way belonging to the San Gabriel Protection District. The profile and cross sections are shown on Plate XXXVIII. The upper Rubio Wash waters are carried in a concrete conduit to a point just below the Pacific Electric Railway tracks. From this point it will be necessary to do bank protection practically the entire distance. Immediately below the mouth of the concrete conduit it will be necessary not only to put in bank protection but check dams across the channel in order to prevent scouring and deepening of the channel. This work has been undertaken and carried out by private parties. It will only be necessary to maintain these works. Lower down it will be necessary to put in bank protection consisting of brush and wire fences, and on the lower end of the wash to build dikes to cause erosion.

A general description of the land, rights of way, easements and property proposed to be taken, acquired or injured is as follows:

A strip of land 100 feet wide described as follows:

Beginning at a point in Maple Avenue approximately 400 feet west of Pine Street; thence in a general southerly direction following the present course of Rubio Wash to a point on the San Gabriel and El Monte Road approximately 200 feet west of Fourth Street.

A strip of land 60 feet wide described as follows:

Beginning at said last mentioned point and extending in a general southerly direction along the right of way now owned by the San Gabriel Protection District, the lower end of which is approximately 1000 feet east of the intersection of Rosemead and Garvey Avenues; all as more fully shown on Plate XXXVII.

The work herein described will cost \$10,090.00.

ALHAMBRA WASH

Plate XXXIX shows the general plan of Alhambra Wash. The profile and cross sections are shown upon Plate XL. In general the present stream bed will be followed. The rights of way necessary for this work are shown between the red lines on Plate XXXIX. At this time it is thought that the work need not go above Pomona Boulevard. The work will consist of the construction of brush and wire fences to prevent bank erosion to a point below Garvey Avenue, where the banks of the stream become low, and from this point on in clearing the willows from the channel and putting up earth dikes necessary to prevent the water from spreading broadly over the fertile lands between there and the Rio Hondo.

A general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured, is as follows:

A strip of land of varying width described as follows:

Beginning at a point in the line between the property owned by J. D. Gilliland and Herman Stephenson, said point being 400 feet west of the west line of lands of Ira O. Gardiner, Trustee; thence in a general southeasterly direction following the course of the present bed of the Alhambra Wash crossing Pomona Boulevard at a point 550 feet west of Del Mar Avenue.

A strip of land 75 feet wide described as follows:

Beginning at said last mentioned point and following the general course of the present bed of the Alhambra Wash in a southeasterly direction crossing Garvey Avenue at a point 150 feet west of San Gabriel Boulevard and continuing in a general southeasterly direction along the present channel of the Alhambra Wash to its junction with the Rio Hondo or the Lexington Wash at a point on Nieto Avenue approximately 100 feet north of the

northeast corner of the lands of Mary F. Lieber; all as more fully shown on Plate XXXIX. The work to be done will cost \$9,835.00.

WEST WHITTIER FLOOD CONTROL

Plate XLI shows plan, profile and cross sections of the work to be done to control and adjust the flood conditions in the vicinity of the Whittier Boulevard and the Workman Mill Road. The concrete channel will be built from Magnolia Avenue to a point 400 feet east of the San Gabriel River, as shown upon Plate XLI.

This ditch will take care of the water now coming down the Workman Mill Road, which causes such an annoyance around the pumping plant of the City of Whittier.

A general description of the lands, rights of way, easements and property proposed to be taken acquired or injured is as follows:

A strip of land 30 feet wide described as follows:

Beginning at a point 1600 feet southerly of the intersection of Magnolia Avenue and Lemon Street at the center line of an unnamed street; thence in a general westerly direction to the right of way of the Salt Lake Railroad; thence north-westerly along the northerly side of said right of way to the Workman Mill Road near the northerly corner of the lands of Harriet W. R. Strong; thence southwesterly along the Workman Mill Road, to a point approximately 500 feet distant.

A strip of land 40 feet wide described as follows:

Beginning at said last mentioned point and running thence north-westerly along a lot line to the north-west corner of the lands of Laura E. Brodrick; thence continuing in a general northwesterly line along the southerly line of the lands of the Citrus Grove Heights Company to the channel of the San Gabriel River all as more fully shown upon Plate No. XLI. The estimated cost of this work is \$20,940.

COMPTON CREEK

Plate LV is a map, of the territory traversed by Compton Creek. Plate LVI is a profile and cross section of this stream from Vermont Avenue to the southerly line of the City of Compton. Compton Creek will be widened, deepened and straightened to provide for the flood water of this territory locally.

This construction work will take care of the waters now causing so much damage, not only to the city of Compton, but above.

The lands, easements and rights of way, necessary to be taken, acquired or injured for these works may be generally described as follows:

A strip of land 50 feet wide beginning at a point at the intersection of Vermont Avenue and 98th Street; extending in a general southeasterly direction following in general the present bed of Compton Creek, to the northwest corner of the City of Compton; thence continuing in a general southeasterly direction following the course of Compton Creek to near the intersection of the Long Beach branch of the Pacific Electric Railway with the southerly line of the City of Compton; thence continuing in a general south-easterly direction to the bridge of the Southern Pacific Railroad over Compton Creek; thence continuing in a general south-easterly direction practically parallel to the Long Beach branch of the Pacific Electric Railway to the Los Angeles River, all as more fully shown on Plate LV.

The cost of the work will be \$20,000.

SANTA CLARA RIVER AND TRIBUTARIES

The work to be done on the Santa Clara River and its tributaries is shown upon Plate LIX, which is a map of this territory. Plate No. LX shows a profile and cross sections of the work to be done. On the Santa Clara River in Sections 20 and 21, Township 4 North, Range 15 West, S. B. B. and M., the work will consist of either a single or double row of posts with brush and trash either against or between them.

For the north bank of the Santa Clara River beginning at a point about 1000 feet west of the mouth of Bouquet Canyon and running thence in a westerly direction for a distance of 4000 feet, there will be used a row of 20-foot piling spaced 8 or 10 feet apart and driven about 15 or 16 feet into the ground with wire placed upon them.

Similar protection will be used on the west bank of Newhall Creek for a distance of approximately 8100 feet, south of the Southern Pacific Railroad.

The protection work for Castaic Creek will be a 500-foot extension down-stream of the present protection work at this place, and will be of the same type as that used upon the Santa Clara River, namely: 20-foot piling faced with wire.

In the small canyons situated in the headwaters of Newhall Creek there will be expended the sum of \$2740 for the construction of check dams to aid in the retardation of the flood waters and to further preserve the same for beneficial use. The entire cost of the work on the Santa Clara River and its tributaries including check dams is \$40,000.00.

Following is a general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured in carrying out the above described work:

A strip of land 150 feet wide beginning at a point on the south line of Block 54, St. Johns Subdivision, and about 250 feet west of the southeasterly corner of said Block 54; running thence in a northerly direction nearly parallel to the Southern Pacific Railroad and the County Boulevard a distance of approximately 8100 feet to the bridge on the Southern Pacific Railroad; this said strip of land being the present bed or channel of Newhall Creek.

A strip of land 300 feet wide beginning at a point 1000 feet west of the mouth of Bouquet Canyon and extending nearly due west a distance of 4000 feet and being the present bed of the Santa Clara River.

A strip of land 150 feet wide extending through Sections 20 and 21, Township 4 North, Range 15 West, S. B. B. and M., and being the present bed of the Santa Clara River through these Sections.

A strip of land 150 feet wide beginning at a point at the east end of the present protection work done by Los Angeles County, and extending westerly and southerly to where the Saugus and Ventura Highway crosses said stream a distance of about 4000 feet, said strip of land being the present bed or channel of the Castaic Creek; all as shown on Plate LIX.

Already the general plan of the protection work in this district has been endorsed in the following terms by the Board of Trade of Saugus and the Newhall Improvement Club:

"We heartily approve of your plan for flood control for the Santa Clara and tributaries, and we promise to support the measure to our fullest extent.

"We appreciate the consideration shown this district and when the matter comes up for election, we will do our share towards carrying the proposition.

"(Signed) SAUGUS BOARD OF TRADE,
Willis M. Baum, Secretary and Treasurer."

"We, the Newhall Improvement Club, of Newhall, California, heartily endorse your attention and appropriation for the Santa Clara and its tributaries which are very destructive to our valley.

(Signed) NEWHALL IMPROVEMENT CLUB,
A. C. Swall."

LITTLE ROCK CREEK AND BIG ROCK CREEK

These water sheds lie upon the north slope of the San Gabriel Mountains, and discharge their flood waters into that portion of Los Angeles County lying north of Los Angeles County Flood Control District. Check dams to the cost of \$10,000 will be constructed in the small canyons which make up the headwaters of Big Rock Creek, and to the cost of \$10,000 in the small canyons which make up the headwaters of Little Rock Creek. These works will add to the conservation of water for beneficial use of the settlements of Little Rock and

Llano. The cost of the work in these two water sheds will consist almost entirely of the outlay for labor, which can be furnished locally. The total amount to be expended on these two streams is \$20,000.

LOS ANGELES RIVER AND THE TWO TUJUNGAS

The waters from the Big and Little Tujunga water sheds debouch into the San Fernando Valley at a common point, for a short distance mingling as one stream, then dividing, a portion flowing to the left and toward Burbank, while the larger portion continues southwesterly toward the Southern Pacific Railroad line known as the Valley Line, where it passes under this railroad in two places, forming what is known locally as the West Channel, then continuing on southward a distance of about three miles toward the Southern Pacific Railroad line known as the Coast Line; but before this second line of railroad is reached the waters again divide, the smaller portion again going to the left or to the eastward, forming what is known locally as the Middle Channel. After the main channel passes the Coast Line the depression through which it flows presents the characteristic features of a small valley approximately 1500 feet in width, and 12 to 15 feet lower than the side benches. The ground or physical features here indicate that at no remote period the waters of the Pacoima Canyon also entered this little valley at about the intersection of Twenty-second Avenue and Twelfth Street. In fact some of the remaining early settlers of Los Angeles County still call the water course below this railroad the Pacoima Wash.

The work to be done in protecting against these Tujunga waters is the effectual repair of the present rock dike or levee which now extends from the Valley Line branch of the Southern Pacific Railroad to the mouth of the Tujunga Canyons. The rock dike above the opening to the east will be repaired by the continuing of the present standard gauge track to the spur of the mountain on the east side. Large derrick stone of one to two tons weight will be placed upon the inner or water side of the levee. This class of construction will also be continued southward from the Valley Line branch of the Southern Pacific Railroad to the Coast Line branch and upon the east side of the present flood zone, a distance of three miles. Upon the west or right-hand bank, and beginning at the Valley Line branch of the Southern Pacific Railroad, about a mile of this class of construction will be extended northward. A low earth embankment, averaging 3 to 4 feet in height, will first be built upon which to place a standard gauge railroad track for the hauling in and placing of the heavy stones upon the inner or water side. From the Coast Line branch of the Southern Pacific Railroad southward toward the Los Angeles River, the same class of construction will be used on either or both sides of the Tujunga Wash. On the dangerous bends the wash will be straightened by river training, using a double row of piling with wire on the stream face, and filled in between with brush and rock. Plate LVII is a plan of the work to be done.

A general description of the right of way or easement required for this work is: A strip of land which is the present course or channel of the flood waters of these canyons, beginning at a point on Foothill Avenue about 700 feet northerly of the intersection of Garfield Avenue and Foothill Avenue, and running thence in a southwesterly direction about 1400 feet to a point on Hayes Avenue about 300 feet southwesterly of the intersection of Hayes Avenue and Eleventh Street; thence in a southwesterly direction 650 feet; thence in a southwesterly direction a distance of about 2 miles to a point on the Southern Pacific Railroad a distance of 500 feet easterly from Hayes Avenue; thence continuing in a southwesterly direction about 2 miles to a point on Twentieth Street about 260 feet westerly from Cleveland Avenue; continuing thence in a southwesterly direction a distance of about 1¼ miles to the Coast Line of the Southern Pacific Railroad a distance of about 800 feet westerly from Cortez Avenue; continuing thence in a southeasterly direction a distance of about 3 miles to a point on Sherman Way about 200 feet east of Diaz Avenue; continuing thence in the same southeasterly direction ¼ mile to a point on Fourth Street about 500 feet east of Diaz Avenue; thence in a southerly direction 2000 feet to a

point about 700 feet east and 600 feet north of the intersection of Diaz Avenue and Third Street; thence in an easterly direction a distance of 2300 feet to a point on Third Street 350 feet east of Encino Avenue; thence in a southeasterly direction a distance of about 3800 feet to a point on Second Street 460 feet east of Pacoima Avenue; thence in a southeasterly direction a distance of 1600 feet to a point about 680 feet south and 730 feet west of the intersection of Second Street and Eucalyptus Avenue; thence in a south-easterly direction to the center of the Los Angeles River, as shown by Plate LVII. Profile and cross sections are shown on Plate LVIII.

Between the two side lines of the proposed protection, the width varies from 2,000 to 3,000 feet. The amount of money required to do this work is \$270,000.

The work to be done upon the Los Angeles River between the mouth of the Big Tujunga Wash and the mouth of the Arroyo Seco, will consist of the removal of brush and other vegetable growth from the present channel along its present natural meanderings. The cost of this work will be \$10,000.00.

The lands, rights of way and easements necessary to be taken, acquired or injured in the prosecution of the above work are described as follows:

The right of way for the Los Angeles River with a varying width of from 400 to 1000 feet begins at a point about 900 feet north of the Los Angeles and Ventura County Road near Pacoima Avenue about two miles southwesterly of Lankershim, continues in a general easterly direction and north of the Los Angeles and Ventura County Road through the City of Burbank following the general meanderings of the stream through Sections 22, 23, 24 and 27 to Griffith Park near Crescent Street and Sonoma Avenue, thence southeasterly and north and east of Griffith Park and Reservation to a point about 600 feet west of the Southern Pacific Railroad and about 1000 feet north from where Verdugo Wash reaches the river, thence southerly along Griffith Reservation to the Pacific Electric Railway Trestle just east of Woodstock Avenue and Los Feliz Road Crossing, thence easterly about $\frac{3}{4}$ of a mile through the Le Brun tract to the rock levee west of the Southern Pacific Railroad, thence south-easterly a distance of about one mile to a point about 1000 feet south of the old city boundary of Los Angeles, thence easterly about one-third of a mile to the Sedalia Villa tract, thence southeasterly about three-fourths of a mile to the Southern Pacific bridge across Los Angeles River just north of Baxter Street at Elysian Park, near the point where Arroyo Seco reaches the Los Angeles River, and as more particularly shown upon Plate LXI. Profile and cross section are shown on Plate LXII.

The total cost of the work on the Los Angeles River and the two Tujungas will be \$280,000.00.

SAN GABRIEL VALLEY

Many people have come into my office and stated that the amount of water flowing in the various channels of the County is continuously on the increase, and asked me to give them an explanation of the fact. The majority of them are of the opinion that the increased runoff in their particular locality is caused by the diversion of waters by their neighbors higher up. Unfortunately in some instances this is the case, but in the great majority of cases the increased runoff is due to perfectly natural causes. The main one of which is the increase of impervious surface due to the construction of roads and buildings, and the increased runoff due to the cultivation of the fields. I have shown on Plate LI the outline of a square mile of virgin territory of this County when it is covered by grass or shrubbery, later by grain and alfalfa, and still later by highly improved farms.

When the first graded road was placed around the section 1.88% of the total area of the section was thrown into the road, which necessarily was a hard, graded, rather impervious surface, causing a quickened runoff. When the section was quartered, nearly 4% of its area went into roads which as a rule were even more impervious. When the section reached the 10 acre size 15% of such area went into such surface. When it reached the $2\frac{1}{2}$ acre size, 28% of the original area becomes streets and roads. These streets are usually

oiled macadam and absolutely impervious, with the result that from 28% of the land we get immediate, precipitous runoff.

This is not the only cause of accelerating flood waters. The former native vegetation, which was a retarding or mulching agent has been removed and in most cases the land carefully graded down, either for high class tillage, orchard cultivation, or beautiful homes, while barns and sheds have been built until there is practically no retention of the rain water upon the area within the streets and boulevards. These are the reasons for the hurried runoff and the appearance in almost every locality each year of more flood waters than ever before. I have letters from many old settlers of the San Gabriel Valley who say that one inch of rain at the present time produces more runoff than three inches did thirty years ago, and I am quite convinced that their statement is not only conservative now, but that the storm runoff has not yet reached its maximum.

The inconvenience of having the roadside ditches and other smaller water courses filled with detritus after every storm is brought about in some degree by the improper cultivation of the foothill slopes. These slopes, where the cultivation runs up and down, or normal, with the slope, and which are not given a winter cover crop to hold the soil, continue to denude themselves of their fertility, and deposit it in the stream courses and gutters below, to the injury of the property owners lower down. These slopes which annually lose their fertility by denudation but a few years ago were covered with vegetation and grass which held these soils, which the land owner now is losing with every rain storm.

Both the Harbor Engineers and the United States Engineers assure me that the greater part of the silt which is deposited in the Harbor comes from only a few miles inland, and is of the finer quality which makes up the rich loam of the lower valley.

A careful analysis has been made of some of the silt removed from the Harbor, and it has been found to consist very largely of silt similar to that found from five to ten miles back from the ocean front and not to be made up of the silts that are washed down from mountain slopes.

Plates LII, LIII and LIV are presented to you to illustrate another form of study. These three plates which are taken at random from our maps, show the overflow or denuded area along washes in this valley. The heavy parallel black lines show narrow conduits and protection walls which the owners have desired the storm waters to pass through, the sanded areas, with the figures enclosed in circles along their edges, show something of the size that Nature demonstrates she must have for storms during flood times. In other words, it shows the futility of man trying to resist Nature. These great devastating floods do not come annually; sometimes they are many years apart, but when they do come they are no respecters of man's idea of small channels.

It has been the effort of this department in securing easements for official channels to prevail upon the property owners and to show them the necessity and propriety of giving to the County at once for improvement as much area as that stream itself demands it must have for a channel. The small figures placed in the circles at the margin of these sanded areas, show the depths of the channels or the heights of the new banks made by the very last storm, February 18, 1916. I have given these reasons to the adjacent land owners why they should give us easements for wide areas; first: that sufficient area might be provided where the stream in flood may have an opportunity to drop its detrital load upon such slopes and in a manner which it knows better than man and insists upon following; secondly that a large area may be supplied for absorption and percolation of the flood waters for the replenishment of the underground water supply; and third that the owner may be protected against going again into these washes and improving them to again lose the fruits of his labor, or that an innocent buyer in the future may not be persuaded to purchase property during dry years in these dangerous localities.

The discussion of the three foregoing phases should not be taken as a criticism, but

as an appeal for a better understanding of some misunderstood conditions, and for pulling together and helping to bear each others' burdens.

SAN GABRIEL CONE

That portion of the San Gabriel River where it emerges from the mountains down to a point near the center of Section 6. T. 1 S, R. II W., a distance of over 5 miles, is shown on Plate XLII. Plate XLIII shows cross section and profile of this section of the river. The work required is the excavation of a channel 400 feet wide and 4 feet deep to form a minor or interior channel. The material from this excavated channel is to be placed in levees upon either side of the channel, and at a distance varying from 600 feet to $1\frac{1}{2}$ of a mile, as shown upon the Plate. This boulder material is to form levees which will be 12 feet wide on top, the slope on the water side will be 3 horizontal to 1 vertical, and upon the back or land side will be $1\frac{1}{2}$ horizontal to 1 vertical; the elevation of the tops of these levees to be 18 feet above the bottom of the minor or interior channel. This minor channel will provide for the carrying of ordinary floods, say up to 20,000 second feet, while when the great floods of 40,000 or 50,000 cubic feet per second come, the entire area between levees amounting to 2,500 acres will be flooded, thereby providing a large spreading ground. This design of a minor and major channel will have a tendency to hold the principal thread of the main current near the center of the minor or deeper channel, and thereby reduce the velocities near the levees, on the whole having a tendency to arrest velocity and precipitate the detritus, and to cause as much of the flow as possible to percolate and reach the artesian water through the coarse materials at the head of the valley. Plate XLII shows where the waters are to be equally divided, one-half of the water flowing down the East San Gabriel River channel to Alamitos Bay, and one half down the West San Gabriel River or Rio Hondo channel to the ocean via Dominguez. To make the matter plain and distinct, the division is to be 50-50: 50% to the eastward and 50% to the westward; and from this point of division down to the end of the two branch channels, the same manner of treatment in the way of channels and embankments or side levees is to be built as is shown above the point of division.

The distances at which the side levees or embankments are to be placed from the interior channel are shown upon the map. It should now be distinctly understood that the plan of the channel here outlined, and for that matter, any other channel in a detrital country, will require examination and correction after every flood. Great floods coming out of the San Gabriel Canyon always, when at peak, bring great loads of detrital matter which are dropped by a very sensitive natural law as the velocity or carrying power of the stream weakens with every slight reduction of the gradient, and a heavy part may be dropped by one storm a short distance down this very large channel, while the next flood wave being larger or smaller, may drop its load farther down, or higher up. This condition must be watched with a vigilant eye and removed so thoroughly after each storm as to bring both the minor or interior channel, and the larger or major channel to a carrying capacity. If this maintenance is neglected disaster will follow.

Following is a general description of the land, easements and rights of way and property to be acquired or injured on the work of the San Gabriel Cone.

A strip of land varying in width from 1600 feet to more than a mile, beginning at a point where the San Gabriel River emerges from its canyon northerly of the City of Azusa, thence in a general southerly direction to a point approximately 1000 feet north and 500 feet east of the intersection of Monroe Street and Michigan Avenue in Chicago Park, at which point the San Gabriel divides into two streams, one of whose branches (Lexington Wash) may be described as a channel varying in width from 2720 feet to 760 feet at the Peek Road and Clark Street in said Chicago Park. The other branch of which may be described as a channel varying in width from 3360 feet at the bifurcation of said streams to a width of 1680 feet at the crossing of the Pacific Electric track just northeasterly of the Cogswell tract, all of which is more fully shown upon Plate XLII.

The amount of money required for the work on this section is \$350,000.00.

EAST SAN GABRIEL RIVER BELOW BASSETT BRIDGE

The right of way necessary for the San Gabriel River is shown between the red lines upon Plate XLIV. The profile is shown on Plate XLV. The river will follow its present course in general, except where as is shown on the map, the large bends will cut. From the Bassett Bridge approximately to the crossing of the Salt Lake Railway the treatment of this river will consist of training works, utilizing a double row of piling faced with wire with brush between. From the crossing of the Salt Lake Railway to the Pacific Electric bridge just east of Rivera the channel is in fair shape. It is recognized by this office that the trees growing along the sides of River channels are of inestimable benefit in keeping the water within bounds. For a quarter of a mile south of the Pacific Electric bridge just east of Rivera the river is in bad shape, threatening to leave its old channel and depart across country to the eastward. Here it will be necessary to drive a double row of piling behind which a strip of willows and brush will be grown. From this point, with a slight amount of work the river will be placed in good condition to a point approximately half a mile above the Southern Pacific Railroad bridge at Studebaker. At this point, a training dike will be built causing the river to cut the east bank and straighten itself, passing down through the span at the east end of the Southern Pacific Railroad bridge at Studebaker, and thence into the channel owned by the New San Gabriel Levee Protection District. From this point to tide water it will be necessary to widen the present channel and to raise the levees along the sides of the bank in order to keep the water within its present confines.

The following is a general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured in the construction of the San Gabriel River channel below the Bassett Bridge:

A strip of land 500 feet wide described as follows: Beginning at a point on the Pomona Boulevard approximately 1700 feet west of Covina Boulevard at Bassett; thence in a general southerly direction following the meanderings of the East San Gabriel River crossing the Whittier Road approximately 2000 feet east of the Lexington and Gallatin Road, and continuing in a general southerly direction to a point approximately 2200 feet east of said Lexington and Gallatin Road on the Rivera and Los Nietos Road; continuing thence in a general southerly direction following the meanderings of the San Gabriel River, and crossing the Norwalk and Orange County Line Road approximately 1900 feet easterly of the intersection of the New River School House Road and the Washburn Crossing Road; and continuing thence in a general southerly direction along the right of way of the New San Gabriel River Protection District to the sea at Alamitos Bay, all as more fully shown upon Plate No. XLIV.

The cost of this work is estimated at \$150,000.00.

RIO HONDO OR WEST SAN GABRIEL

The Rio Hondo, which is a bifurcation of the San Gabriel River just above El Monte, presents a good opportunity for river training. Plate XLVI is a map and Plate XLVII a profile of the Rio Hondo from El Monte to the Los Angeles River.

The channel of this stream should be straightened as much as possible, confining it within its present banks, and in certain places making small cuts across points.

The methods of handling this wash will be to construct training dikes to hold the water within the right of way shown between the two red lines on Plate XLVI. It is thought that the best way to handle this wash is to utilize the power of the flowing stream and cause it to make the necessary cuts, depositing the material in the bends below. By this method of treatment it is hoped that in a comparatively few years much of the devastated area can be reclaimed and put to beneficial use. From a point just above the Mission Bridge to the Foster Bridge the Rio Hondo flows along a high, hard mesa lying to the west, and it will be necessary along this stretch of the river to take care of the east bank only.

From the Foster Bridge to just above the Southern Pacific Railroad (Santa Ana Branch) the Rio Hondo is within the limits of the San Antonio Protection District. The piling and the bank protection work done by this District over this stretch of the river are adequate for present

needs. From where the Rio Hondo breaks out of the right of way of the San Antonio Protection District to the Los Angeles River, bank protection is to be placed adequate to preclude a break similar to that of 1914. This river training is to be accomplished by the construction of a double row of piling faced with wire and filled with brush.

The following is a general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured in the construction of the East San Gabriel River channel below the Bassett Bridge:

A strip of land 500 feet wide beginning at a point in the Peek Road approximately 3250 feet southerly of the intersection of Peek Road and the Dalton County Road; thence following the general meanderings of the Lexington Wash (Rio Hondo or West San Gabriel River) in a southerly direction to a point approximately 1000 feet northerly of the north line of the King Tract, in the City of El Monte.

A strip of land of varying width extending from said last mentioned point in a general southerly and southwesterly direction following in a general manner the course of the Lexington Wash to the southerly line of land now owned by the Huntington Land & Development Company.

A strip of land 500 feet wide beginning at said last mentioned point and going in a general southeasterly and southerly direction following the general course of the Lexington Wash passing under the Valley Road at the westerly end of the Mission Bridge, and continuing thence in a general southwesterly direction and passing under the Whittier Road approximately 1000 feet easterly of First Street, in the town of Newmark (Montebello); thence continuing in a general southwesterly direction under the high bluff on the west and crossing under the Anaheim Telegraph Road at a point 1500 feet northwesterly of the Telegraph and Jaboneria Road; continuing thence in a southwesterly direction to the southerly corner of the Gage Home Place and passing under Foster Bridge; thence continuing in a general southwesterly direction along the right of way of the San Antonio Protection District to the first curve above the Southern Pacific Railroad; thence leaving the right of way of the San Antonio Protection District approximately at the northeasterly corner of the land now owned by the Grant Brothers Construction Company, and continuing in a southwesterly direction to junction with the Los Angeles River just northerly of the Alexander Gunn Tract No. 2, all as more fully shown upon Plate No. XLVI.

The estimated cost of the work is \$125,000.00.

LOS ANGELES RIVER, SOUTH CITY LIMITS TO DOMINGUEZ

The green coloring upon Plate XLVIII shows the channel followed by the last flood to have a course generally within this right of way, which is suggestive in itself that the position of the official channel to be acquired is in the lowest part of the Los Angeles Valley. The river may not only be trained to remain within the limits of this right of way, but its own force may be used to straighten the channel.

It is a well known observation that the Los Angeles River in the lower valley never has cut a channel for itself deeper than a few feet and a study of the cause of the river's refusal to go down or deepen its channel was made during the flood season of the past two years. It was discovered that the bottom of the water in the channel was always coincident or level with the plane of the ground water in the valley, which in the rainy season, ranges about four feet below the surface. The material, both above and below the water plane, being silt, the river cannot scour itself below this great plane of ground water, the silt material refusing to stand above it.

Should ample means be provided in the future for the straightening of the river channel, by placing a railroad track on each bank for the depositing of heavy riprap to hold the banks, I have no hesitancy in saying that the river then would deepen its channel much below the surface of the plane of the present ground water, and instead of having a meandering delta stream, a deepened stream channel would result.

Plate XLVIII is a map, and Plate XLIX a profile of the proposed channel of the Los

Angeles River from the Los Angeles City limits southward to the ocean. The right of way necessary is shown between two red lines, and varies in width from 300 feet where it leaves the city to 800 feet further down. Free easements for about three and one-half miles of this right of way are now in my hands. In general, the work to be done on the Los Angeles River will consist of driving a double row of piles faced with hog wire, with brush between. The method to be pursued in handling this river is river training, which will consist of building dikes in the above described manner at the various bad bends, causing the river to straighten its present tortuous channel, and confining it within a definite and fixed channel, protecting the land on either side.

The following is a general description of the lands, rights of way, easements and property proposed to be taken, acquired or injured in the construction of the Los Angeles River channel.

A strip of land varying in width described as follows:

Beginning at the intersection of the present bed of the Los Angeles River with the southerly boundary of the City of Los Angeles, thence following the present course of the Los Angeles River in a general southerly and easterly direction to a point approximately 1400 feet east of the intersection of Downey Road and Vernon Avenue.

A strip of land 500 feet wide beginning at said last mentioned point, and following the present course of the Los Angeles River in a general easterly and southerly direction and crossing the Laguna Road approximately 1000 feet easterly of Baker Street, and continuing from thence in a general southerly direction to the junction of the Los Angeles River and the Rio Hondo near the northwest corner of the Alexander Gunn Tract No. 2.

A strip of land 800 feet wide beginning at said last mentioned point and extending in a general southerly direction, following in a general way the course of the Los Angeles River, crossing Washington Street about 900 feet easterly of Gibson Street and continuing southerly along the present channel of the Los Angeles River to the Cerritos trestle on the Pacific Electric Railway track near the easterly end of Carson Street; all as shown on Plate XLVIII.

The total cost of this work is \$350,000.00.

LOS ANGELES AND LONG BEACH HARBOR PROTECTION

For the protection of the Los Angeles and Long Beach Harbors from the storm and flood waters of the Los Angeles and San Gabriel Rivers and the Rio Hondo, said waters are to be brought to the sea between Long Beach Harbor and the residential portion of the City of Long Beach. This is to be accomplished by the construction of a dike parallel to and northerly of the Pacific Electric Railway tracks, and extending south-easterly from the high land of Dominguez Hill, causing all the waters of said streams to flow to the location of the present Pacific Electric bridge over the Los Angeles River, locally known as Cerritos Trestle, and by the construction of parallel levees confining the said waters in their course from said bridge in a straight channel extending almost due south to the Pacific Ocean at a point between Parker and Wabash Avenues in the City of Long Beach. The plan of this work is shown on Plate XLVIII; a profile and cross section of the proposed channel is shown upon Plate XLIX.

The lands, easements, rights of way and properties to be acquired or injured in carrying out this portion of the work may be generally described as follows:

A strip of land 200 feet wide, beginning at the crossing of the Pacific Electric Railway Long Beach Branch and the Southern Pacific Railroad, on the lands of R. G. S. Dominguez; thence in a general south-easterly direction along the north-easterly side of the right of way of said Pacific Electric Railway to the Cerritos trestle crossing the Los Angeles River.

A strip of land varying in width from 720 to 1000 feet from said last mentioned point to Wilmington Street Extension, said point being westerly of the Pacific Electric Railway, approximately 1700 feet.

A strip of land 720 feet wide, beginning at said last mentioned point and following in a general southerly direction the present course of the Los Angeles River to the intersection of Ayres Avenue and Anaheim Street.

A strip of land 600 feet wide extending from said last mentioned point southerly along the present course of the Los Angeles River to approximately Crescent Street, thence continuing in a general southerly direction to the Pacific Ocean, approximately at the foot of Morgan Avenue in the City of Long Beach; all of which said right of way is more fully shown upon Plate XLVIII.

The right of way above described for the Los Angeles River channel from Cerritos trestle to the Pacific Ocean and from the proposed dike is to be acquired by the District. The District is also to construct the necessary roads and bridges, to adjust all damage claims and to maintain the works after construction. The construction work itself is not provided for in this report, for the reason that it will undoubtedly be undertaken by the United States Government. The sum of \$1,080,000 has been provided by the Federal Government and of this amount \$500,000 has already been made available by Congress to be expended for the protection of the two harbors concerned. This item was included in the River and Harbor Bill adopted by the U. S. Congress and approved July 27, 1916. By such Act, however, the work is to be done in accordance with the report of the U. S. Army Engineers, printed in House Document No. 462, 64th Congress, 1st Session, approving the so-called plan "D" for the diversion of the waters approaching the harbors by constructing a dam from Dominguez Hill to the high land at Los Cerritos, and a channel thence to the sea at Alamitos Bay hereinafter referred to as the tentative route. The modified route proposed in this report has the personal recommendation of the U. S. District Engineer in charge of Government work at the Los Angeles Harbor, and will undoubtedly be approved by the Federal Government. The city officials of Los Angeles and Long Beach have concurred in this change of route.

The points in favor of the modified route I have proposed are as follows:

1. Its diversion dike will be only about 50% of the length of the dike necessary upon the tentative route.
2. Its channel to the ocean will be but 60% as long as the channel by the tentative route.
3. Its slope or gradient will be nearly 8 feet per mile, which is almost double that of the tentative route.
4. It is almost free from curves.
5. It will permit the keeping of the waters of the Los Angeles and West San Gabriel Rivers entirely within their own valleys, and thereby avoid litigation by owners of the lands upon the east side, who say they will resist legally the turning of these waters out of their own valleys.
6. There will be no arresting of the flood waters, or the tendency for the formation of a lake upon its oblique dike, as in the case of the dike upon the tentative route.
7. In the matter of the construction of either route the construction would necessarily begin at the ocean and the efficiency of the diversion by the way of the tentative route would not be complete until the whole ten miles of the channel and dikes were constructed, while upon the modified route after the work begun at the ocean would have advanced but four miles inland, it would even then be in a position to carry a large flood from the harbor.
8. The cost of the right of way will be less than by the tentative route.
9. The cost of the bridges will be less.
10. The possibility of litigation with the Palos Verdes Syndicate about the riparian rights, with which they allege the Dominguez Dike will interfere, will be entirely eliminated by the modified route.
11. It should be plain from paragraphs 3 and 4 that the shorter and straighter channel, and one with double the fall, would be a less expensive one to maintain.

12. The two parallel wide levees from the Cerritos trestle to Long Beach industrial district will have valuable rental or sale values from the District to the railroads entering the industrial district of both Los Angeles and Long Beach Harbors.

It is expected that the same conditions will again be exacted by the United States with regard to co-operation of the district namely, that the necessary rights of way be provided, costs of necessary roads and bridges be met, all damage claims be adjusted and improvements be maintained after completion, by the District.

It is confidently expected that the U. S. Government will undertake the construction work via modified route for the protection of the harbor, and no money is provided for construction in this section of the work.

The specifications for the highway bridges shall conform to the standard practice of Los Angeles County.

The cost of bridges is \$308,900, and for rights of way and damages and maintenance \$864,100. A total cost for harbor protection of \$1,173,000.00.

This Report also contains electrotypic reproduction of extracted maps from the latest reports relative to the control of floods in Switzerland, Austria and France, showing the Swiss methods of confining and leveeing their detrital streams at their deltas, along with their use of heavy riprap. Photographs are also taken from Swiss reports showing scenes of recent canyon devastation in those countries. These scenes appear almost identical with those which may be found in many places along the foothills in this district. Numerous photographs showing common flood conditions in this district are also inserted.

SUMMARY OF ESTIMATES

Harbor Protection for Los Angeles and Long Beach Harbors (Including Work at Dominguez)	\$1,173,000.00
Los Angeles River (South City Limits to Dominguez)	350,000.00
Los Angeles River and the Two Tujunga Rivers	280,000.00
Devil's Gate Dam and Arroyo Seco Work.....	290,000.00
Pacoima River (including Hutchin's Flood Control Reservoir)	359,460.00
Verdugo Wash, Glendale and Vicinity	99,800.00
Sycamore Canyon, Glendale and Tropico Work	28,925.00
Gardena Valley and Nigger Slough	56,590.00
Ballona Creek (West Los Angeles and Venice)	80,875.00
Compton Creek	20,000.00
Pasadena and Altadena	30,320.00
Rio Hondo (West San Gabriel River) via Dominguez	125,000.00
Pomona Flood Control Reservoir and Work on San Antonio, Live Oak, Thompson and Williams Creeks	272,400.00
San Gabriel River Control on Cone Adjacent to Mountains	350,000.00
East San Gabriel River from Cone via Artesia to Ocean Outlet	150,000.00
San Dimas Flood Control Reservoir, Covina and Baldwin Park Protection Work	278,000.00
San Dimas Wash	37,830.00
Big Dalton and Glendora Protection Work.....	99,060.00
Little Dalton Work	26,920.00
Alhambra Wash	9,835.00
Eaton Wash	27,650.00
San Jose Creek Work	8,000.00
Sawpit Wash	4,835.00
Walnut Creek Work	29,920.00
West Whittier Work	20,940.00
Santa Clara River and Tributaries	40,000.00
Santa Anita Work	27,350.00
Little Rock and Big Rock Creeks	20,000.00
Rubio Wash	10,090.00
Haines Canyon	33,500.00
Creek Dams Not Included in Other Items Herein	60,000.00
Incidental Expenses, Including Legal, Clerical, Engineering, Superintendence, Inspection, Printing and Advertising	49,700.00
 Total Estimate of Cost	 \$4,450,000.00

The total amount of bonds necessary to be issued to pay for the foregoing mentioned work is \$4,450,000.00.

I believe that the foregoing plan hereby submitted will control and conserve the flood and storm waters of this District for beneficial use and protect the Los Angeles and Long Beach harbors, waterways, public highways, and property in said District from damage from such flood and storm waters.

Respectfully submitted,

J. W. REAGAN,
Engineer of Los Angeles County
Flood Control District.

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